Snyder, Marcia

From:	Snyder, Marcia
Sent:	Friday, November 9, 2018 5:12 PM
To:	Rawding, Daniel J (DFW); Blane Bellerud NOAA Federal
Cc:	Palmer, John; Merz, Martin; Josie Thompson NOAA Federal; art.c.martin@state.or.us; Rod.A.French@state.or.us; Garrity, Michael D (DFW); Ritchie Graves; John North; Tucker Jones; Ebersole, Joe; Guzzo, Lindsay; Wu, Jennifer; aimee.fullerton@noaa.gov; Paul Wagner; Trevor Conder; Matthew Keefer
Subject:	RE: Columbia River Cold Water Refuges Meeting EPA WDFW ODFW NOAA
Attachments:	Twardek_CR_steelhead2017.pdf; Boyd et al 2010 catch and release.pdf; raby et al 2015 pacific salmon fishing.pdf; Gale et al 2013 Fish and Fisheries temperature capture and release.pdf

Thank you for all the sources and ideas. This is really useful feedback. It seems like there is sufficient support in the literature for temperature to affect catch and release mortality. Clearly, many factors aside from temperature (e.g. gear, species, population, handling time, etc.) determine the severity of the effect. I think barring new research what we can do is synthesize the available information and test how sensitive the model endpoints are to the angling survival curves. The sensitivity analysis of the model can be used to identify how important these assumptions are for fish populations in the migration corridor.

I am attaching a few more recent studies on catch and release on Pacific salmon that are perhaps more relevant than the Atlantic salmon data. Twardek et al. 2018 and Boyd et al. 2010 demonstrate intermediate mortality rates (~10-15%) from elevated temperatures in steelhead and rainbow trout. Raby et al. 2015 and Gale et al. 2013 are more recent reviews suggesting that temperature is indeed an important factor along with a lot of other factors (gear type, injury, air temperature exposure, etc.). Perhaps, most relevant to the ongoing discussion is Gale et al.'s summary statement, "Collectively, the
results suggest that capture–release mortality increases at temperatures within, rather than above, species specific thermal preferenda".

Also, attached is Wilkie et al. 1996 which has the temperature end points I used to develop the current curve in the model.

Thanks again for the enlightening discussion.

Happy Friday,
Marcía

From: Rawding, Daniel J (DFW) [mailto:Daniel.Rawding@dfw.wa.gov]
Sent: Friday, November 09, 2018 11:29 AM
To: Blane Bellerud - NOAA Federal <blane.bellerud@noaa.gov>
Cc: Palmer, John <Palmer.John@epa.gov>; Merz, Martin <merz.martin@epa.gov>; Josie Thompson - NOAA Federal <josie.thompson@noaa.gov>; art.c.martin@state.or.us; Rod.A.French@state.or.us; Garrity, Michael D (DFW) <Michael.Garrity@dfw.wa.gov>; Ritchie Graves <ritchie.graves@noaa.gov>; John North <john.a.north@state.or.us>; Tucker Jones <tucker.a.jones@state.or.us>; Ebersole, Joe <Ebersole.Joe@epa.gov>; Snyder, Marcia <Snyder.Marcia@epa.gov>; Guzzo, Lindsay <Guzzo.Lindsay@epa.gov>; Wu, Jennifer <Wu.Jennifer@epa.gov>; aimee.fullerton@noaa.gov; Paul Wagner <Paul.Wagner@noaa.gov>; Trevor Conder <trevor.conder@noaa.gov>; Matthew Keefer <mkeefer@uidaho.edu>
Subject: RE: Columbia River Cold Water Refuges Meeting - EPA WDFW ODFW NOAA

Blane,
There is no Columbia River Pacific Salmon temperature curve associated with mortality. My last investigation into steelhead sport C&R rates was summarized in the Lower Columbia River FMEP for tributary fisheries over 15 years ago. During the literature review, the summer steelhead hooking mortality review found 8% and 9% in BC (Lirette 1989) and that was approximately double the C&R mortality for winter steelhead from a variety of sources. These are the rates in the FMEP. It would be nice to have the relationship between C&R mortality and water temperature in the Columbia for different populations, species, and races but we just don't have this and this would be a good research topic for the region.
Dan

From: Blane Bellerud - NOAA Federal <blane.bellerud@noaa.gov>
Sent: Friday, November 9, 2018 11:11 AM
To: Rawding, Daniel J (DFW) <Daniel.Rawding@dfw.wa.gov>
Cc: Palmer, John <Palmer.John@epa.gov>; merz.martin@epa.gov; Josie Thompson - NOAA Federal <josie.thompson@noaa.gov>; art.c.martin@state.or.us; Rod.A.French@state.or.us; Garrity, Michael D (DFW) <Michael.Garrity@dfw.wa.gov>; Ritchie Graves <ritchie.graves@noaa.gov>; John North <john.a.north@state.or.us>; Tucker Jones <tucker.a.jones@state.or.us>; Ebersole.Joe@epa.gov; Snyder.Marcia@epa.gov; Guzzo.Lindsay@epa.gov; Wu.Jennifer@epa.gov; aimee.fullerton@noaa.gov; Paul Wagner <Paul.Wagner@noaa.gov>; Trevor Conder <trevor.conder@noaa.gov>; Matthew Keefer <mkeefer@uidaho.edu>
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So what are the post capture survival estimates used for catch and release fishery management in Columbia River fisheries and what is the source of that data?
To presume that temperature has no effect, when a general physiological trend is indicated by related species does not make much sense. We have limits on fish handling based on temperature, and ODFW at least restricted afternoon harvest in the Deschutes River during 2015 in response to high temperatures.
Blane

On Fri, Nov 9, 2018 at 10:51 AM Rawding, Daniel J (DFW) <Daniel.Rawding@dfw.wa.gov> wrote:

> Blane,
> I agree that the Columbia River seining study should be limited to seining. However, Atlantic salmon is a different species with different thermal preferences and it application to Columbia Pacific salmon is not appropriate. The same applies to the Frazier sockeye salmon study you forwarded, and it should be noted that the literature supports sockeye have a lower thermal tolerance than O. mykiss.
>
> I think the most relevant section of my paper is below, that it identifies that thermal adaptation has been observed in sockeye and *O. mykiss*. I hypothesized that this adaptation may explain the why temperature was not an important covariate in the model in the seine study. Although there are likely other reasonable hypothesis.
>
> The challenge moving forward with the proposed model is the we have no information on summer steelhead and fall Chinook C&R mortality as related to temperature in the Columbia basin, and without this the model is subjective and very sensitive to this assumption. This also applies to the other model inputs/assumptions as I mentioned yesterday including residence time (duration) in the cold water refuge, density dependence (capacity) in the refuge, spatial extent of refuge use, number or percentage of "dip-ins" or non-natal fish caught in the refuge. This last sentence is especially relevant to the cold water refuges below BON, and the application to the different environments in White Salmon (Condit Dam removal), and Deschutes (thermal regime) since the U of I radio tagging studies.
> Dan

Dan Rawding
Washington Department of Fish and Wildlife
Columbia River Salmon Recovery Policy
Phone: 360.910.3886

The combination of some data and an aching desire for an answer does not ensure that a reasonable answer can be extracted from a given body of data. ~ John Tukey (1986)

Expert from Rawding et al. 2016.

"Our study did not identify water temperature as an important variable in predicting steelhead detection. The mean water temperature during our study was 19.5°C (range 14.1 22.4 °C). However, Rawding and Bentley (in review) did identify water temperature as an important factor in the survival of steelhead released from recreational fisheries. Based on limited data, they noted mortality for fish hooked in non-critical locations increased rapidly above 19°C for coastal steelhead. Pacific salmon, Oncorhynchus spp., have species and population specific tolerances with respect to metabolic capacity (Eliason et al. 2011) and capture stressors (Donaldson et al. 2012) across a range of temperatures. Pacific salmon adults have high fidelity to natal spawning areas, which has resulted in genetically distinct populations with specific physiological adaptations resulting in local adaptation to the thermal regimes (Lee et al.2003, Eliason et al. 2011). In resident O. mykiss, thermal adaptation has been observed in transplanted strains and supported by genetic evidence (Narum et al. 2010, 2013, Chen et al. 2015). Thermal tolerance for resident (rainbow trout) and anadromous (steelhead) forms of O. mykiss based on field observations in California, Oregon, and Idaho ranged from 29 to 32°C (Li et al. 1994, Nielsen et al. 1994, Rodnick et al. 2004, Zoellick 1999, Werner et al. 2005). This is a similar thermal tolerance for resident O. mykiss acclimated at temperatures above 15°C in laboratory experiments (Sloat and Osterback 2013). Nielsen et al. (1994) observed that the majority of adult and juvenile steelhead migrated to cool water at temperatures above 23°C. Brewitt and Danner (2014) observed that all juvenile steelhead moved into thermal refuge when temperatures reached 25°C. The mode temperature on the date of peak passage of Columbia River steelhead at BON since 1997 was 22°C (Figure 9). This suggests that while O. mykiss may tolerate water temperatures above 29°C, they are likely experiencing thermal stress at water temperatures above 23-25°C, which is above the temperature we observed in our seining study.

Figure 9. Frequency of annual steelhead peak passage at Bonneville Dam by daily scroll case water temperature (°C) from 1997 to 2015. Data was obtained from Corps of Engineers (COE) Annual Fish Passage Reports"

From: Blane Bellerud - NOAA Federal <blane.bellerud@noaa.gov>
Sent: Friday, November 9, 2018 10:26 AM
To: Palmer, John <Palmer.John@epa.gov>
Cc: Rawding, Daniel J (DFW) <Daniel.Rawding@dfw.wa.gov>; merz.martin@epa.gov; Josie Thompson - NOAA Federal <josie.thompson@noaa.gov>; art.c.martin@state.or.us; Rod.A.French@state.or.us; Garrity, Michael D (DFW) <Michael.Garrity@dfw.wa.gov>; Ritchie Graves <ritchie.graves@noaa.gov>; John North <john.a.north@state.or.us>; Tucker Jones <tucker.a.jones@state.or.us>; Ebersole.Joe@epa.gov; Snyder.Marcia@epa.gov; Guzzo.Lindsay@epa.gov; Wu.Jennifer@epa.gov; aimee.fullerton@noaa.gov; Paul Wagner <Paul.Wagner@noaa.gov>; Trevor Conder <trevor.conder@noaa.gov>; Matthew Keefer <mkeefer@uidaho.edu>
Subject: Re: Columbia River Cold Water Refuges Meeting - EPA WDFW ODFW NOAA

This study of Sockeye seems to be far more relevant in understanding the likely effects of increasing temperature on fish which are caught and released.

It also appears that our friends with ODFW and WDFW are concerned that potential efforts to restrict harvest in thermal refugia are aimed at reducing steelhead harvest. I do not think this is the case, rather the aim is to avoid excessively penalizing these fish for using this survival strategy by exposing them to potentially high harvest pressure. There is no suggestion that harvest limits should be altered, only to establish refuges from harvest (which already exist in other locations) in areas where the fish are highly concentrated and vulnerable. High levels of harvest of fish in refugia would have a doubly negative effect if indeed fish which use thermal refugia are more likely to be successful spawners. The highest quality fish (in terms of likely successful reproduction) would be subjected to the greatest harvest pressure.

On Fri, Nov 9, 2018 at 10:11 AM Blane Bellerud - NOAA Federal <blane.bellerud@noaa.gov> wrote:

> Even though Atlantic salmon are a different species, we are talking more about a physiological effect that can be generalize across species, that is increasing negative effects of stress as you approach the critical temperatures of a species. Local adaptation does not seem likely to make that much of a difference either as it is only a few degrees, so the fish are still subject to increased stress. Also at temperatures over 15C most cold water fish pathogens are highly active so the risk of secondary infection from any wounds, abrasions, etc. also increase.
>
> On Fri, Nov 9, 2018 at 10:04 AM Blane Bellerud - NOAA Federal <blane.bellerud@noaa.gov> wrote:
>
> > I would say that the seining study is pretty irrelevant to anything other than the specific gears and methods used- tangle nets and purse seining. Making generalization to gill nets or recreational hook an line catches is a bit of a stretch. Hook and line fisheries capture fish by directly wounding and exhausting the fish, gill nets frequently have soak times of multiple hours. About the only fishery above Bonneville that might be even slightly comprable is the platform dipnet fishery.
> >
> > I also do not think that this study provides any particularly useful information on the effect of temperature on catch and release fisheries. This is primarily due to the great difference in the nature of the capture, handling etc. The Atlantic salmon studies noted would be far more relevant .
> >
> > On Fri, Nov 9, 2018 at 9:24 AM Palmer, John <Palmer.John@epa.gov> wrote:
> >
> > > Thanks Dan,
> > >
> > > Thanks for forwarding the article. In my quick read, I noticed the below paragraph. Is it the case that for seine commercial fisheries temperatures appears not be a factor in catch/release survival, but for recreational catch/release it is?
> > >
> > > John
> > >
> > > Our study did not identify water temperature as an important variable in predicting steelhead
> > >
> > > detection. The mean water temperature during our study was 19.5°C (range 14.1 – 22.4 °C).
> > >
> > > However, Rawding and Bentley (*in review*) did identify water temperature as an important factor

in the survival of steelhead released from recreational fisheries. Based on limited data, they noted mortality for fish hooked in non critical locations increased rapidly above 19°C for coastal steelhead.

From: Rawding, Daniel J (DFW) <Daniel.Rawding@dfw.wa.gov>
Sent: Thursday, November 8, 2018 4:04 PM
To: Merz, Martin; Josie Thompson - NOAA Federal
Cc: Art Martin; Rod.A.French@state.or.us; Garrity, Michael D (DFW); Ritchie Graves - NOAA Federal; Blane Bellerud - NOAA Federal; john.a.north@state.or.us; tucker.a.jones@state.or.us; Palmer, John; Ebersole, Joe; Snyder, Marcia; Guzzo, Lindsay; Wu, Jennifer; aimee.fullerton@noaa.gov; Paul Wagner - NOAA Federal; Trevor Conder - NOAA Federal; mkeefer@uidaho.edu
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Link to steelhead report, I discussed.

https://wdfw.wa.gov/publications/01844/

Survival of Summer Steelhead Caught and Released from an ...

wdfw.wa.gov

A study to determine the survival of adult summer steelhead released from commercial fishing gear occurred from 2011 to 2013. Steelhead were incidentally captured in an experimental Columbia River salmon beach and purse seine fishery (fishery) below Bonneville Dam (BON). Survival estimates were ...

Dan

From: Merz, Martin <merz.martin@epa.gov>
Sent: Thursday, November 8, 2018 3:07 PM
To: Josie Thompson - NOAA Federal <josie.thompson@noaa.gov>
Cc: Art Martin <art.c.martin@state.or.us>; Rod.A.French@state.or.us; Rawding, Daniel J (DFW) <Daniel.Rawding@dfw.wa.gov>; Garrity, Michael D (DFW) <Michael.Garrity@dfw.wa.gov>; Ritchie Graves - NOAA Federal <ritchie.graves@noaa.gov>; Blane Bellerud - NOAA Federal <Blane.Bellerud@noaa.gov>; john.a.north@state.or.us; tucker.a.jones@state.or.us; Palmer, John <Palmer.John@epa.gov>; Ebersole, Joe <Ebersole.Joe@epa.gov>; Snyder, Marcia <Snyder.Marcia@epa.gov>; Guzzo, Lindsay <Guzzo.Lindsay@epa.gov>; Wu, Jennifer <Wu.Jennifer@epa.gov>; aimee.fullerton@noaa.gov; Paul Wagner - NOAA Federal <Paul.Wagner@noaa.gov>; Trevor Conder - NOAA Federal <trevor.conder@noaa.gov>; mkeefer@uidaho.edu
Subject: RE: Columbia River Cold Water Refuges Meeting - EPA WDFW ODFW NOAA

(b) (6)

Martin Merz

Physical Scientist – EPA Region 10

merz.martin@epa.gov

206 553 0205

From: Josie Thompson NOAA Federal <josie.thompson@noaa.gov>
Sent: Thursday, November 8, 2018 3:05 PM
To: Merz, Martin <merz.martin@epa.gov>
Cc: Art Martin <art.c.martin@state.or.us>; Rod.A.French@state.or.us; Daniel.Rawding@dfw.wa.gov; Michael.Garrity@dfw.wa.gov; Ritchie Graves NOAA Federal <ritchie.graves@noaa.gov>; Blane Bellerud NOAA Federal <Blane.Bellerud@noaa.gov>; john.a.north@state.or.us; tucker.a.jones@state.or.us; Palmer, John <Palmer.John@epa.gov>; Ebersole, Joe <Ebersole.Joe@epa.gov>; Snyder, Marcia <Snyder.Marcia@epa.gov>; Guzzo, Lindsay <Guzzo.Lindsay@epa.gov>; Wu, Jennifer <Wu.Jennifer@epa.gov>; aimee.fullerton@noaa.gov; Paul Wagner NOAA Federal <Paul.Wagner@noaa.gov>; Trevor Conder NOAA Federal <trevor.conder@noaa.gov>; mkeefer@uidaho.edu
Subject: Re: Columbia River Cold Water Refuges Meeting EPA WDFW ODFW NOAA

We are having trouble with the conference phone number. FYI

Josie Thompson

Columbia Hydropower Branch

Interior Columbia Basin Office

NOAA Fisheries, West Coast Region

503-231-2313

Josie.Thompson@noaa.gov

On Tue, Nov 6, 2018 at 12:36 PM Merz, Martin <merz.martin@epa.gov> wrote:

> Hello Again – updating the meeting invite with a 2 page document with a simple table and map illustrating our cold water refuge tributaries. This may serve as helpful background for those with less exposure to our project. We're looking forward to the meeting on Thursday!
>
> Hello All,
>
> I'm updating this meeting invite with an agenda, conference line and screen sharing link:
>
> **Conference Numbe** (b) (6)
>
> **Screen Sharin** (b) (6)
>
> Also, as a reminder, you are all encouraged to invite 1 2 others from your agency who may have useful input on different model scenarios we plan on running over the next couple months, including different fishery management scenarios in cold water refuges.
>
> We are looking forward to the meeting!
>
> Hello All,
>
> Thanks everyone for responding to the doodle poll – we miraculously landed on a meeting time that works for all of us: **Thursday November 8th 3-5pm**.
>
> The goal of this meeting will be for EPA to provide a technical update on our work effort, communicating our fish modeling approach and assumptions. We are interested in having a technical discussion following our presentation. We are particularly interested in your perspectives on how fisheries in and around cold water refuges are managed, and how we might be able to best incorporate management options into our model scenarios.

> > > We will follow up soon with a screen sharing link and conference phone line.

> > --
> > Blane L. Bellerud Ph.D.
> > Fisheries Biologist
> > NOAA Fisheries
> > Portland, OR

> --
> Blane L. Bellerud Ph.D.
> Fisheries Biologist
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